

PATENT ABSTRACTS OF JAPAN

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(71)Applicant : **ISHIKAWA KINZOKU KK**

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(72)Inventor : **MATSUMOTO TOSHIO****MURAOKA NAOKI****MASUDA TOSHIYUKI****OMOTO TAKAHIKO****OZAKI JINICHI****(54) LEADLESS SOLDER**

(57)Abstract:

PURPOSE: To obtain leadless solder having good wetting and mechanical characteristics by specifying the compsn. of solder, thereby lowering its melting temp.

CONSTITUTION: This leadless solder consists of a compsn. consisting of 1.0 to 3.0wt.% Ag, 0.5 to 2.0wt.% Cu, 1.0 to 10.0% Bi and all of the balance or the greater part Sn. The finer structures are formed and the mechanical strength is further improved by adding Cu to the essential component Sn added with Ag. The melting temp. is lowered and the thermal damage of parts and printed circuit boards is prevented by adding Bi to the essential component Sn added with Ag and Cu. As a result, the melting temp. is approximated as far as possible to the m.p. of Sn-Pb eutectic solder and the leadless solder having excellent wetting and mechanical characteristics is obtd.

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3. In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1] Composition of solder is all or its unleaded solder which becomes since most of 1.0 - 3.0 % of the weight of Ag, 0.5 - 2.0 % of the weight of Cu, 1.0 - 10.0 % of the weight of Bi, and Sn remainder.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] Since this invention mounts a small chip and semiconductor parts with a sufficient precision on the circuit board of electronic equipment or an electrical machinery device, it relates to the unleaded solder mainly used.

[0002]

[Description of the Prior Art] As for the conventional solder, lead is used so much. It will become an environmental problem if it is left, without processing strong toxic lead when the substrate which used such solder is discarded. For this reason, the development of the solder which contained lead, without using lead, and the unleaded solder which has an equivalent property is hurried.

[0003] As conventional unleaded solder, there are the thing of the composition shown in Table 1, i.e., the thing of an Sn-Ag alloy system, (the conventional example 1), a thing (the conventional example 2) of an Sn-Zn alloy system, and a thing (the conventional example 3) of an Sn-Sb alloy system.

[0004]

[Table 1]

【表 1】 従来例

従来例	組成 (重量%)				溶融温度 (℃) (共晶線)	ぬれ性
	S n	A g	S b	Z n		
1	残部	3.5	—	—	221	□
2	残部	—	—	9.0	199	×
3	残部	—	5.0	—	240	△

[0005]

[Problem(s) to be Solved by the Invention] However, in the conventional example 1 (Sn-Ag alloy system), the melting point may become high with 221 degrees C, and soldering parts or a printed circuit board may be damaged. Moreover, the conventional example 2 (Sn-Zn alloy system) has a problem in soldering in the atmospheric air, in order that Zn may tend to receive oxidization, and it is very bad. [of a wettability] Moreover, the conventional example 3 (Sn-Sb alloy system) has the melting point as high as 240 degrees C, and a wettability is not good, either, and troubles, like Sb has some toxicity are still unsolved until now.

[0006] As everyone knows, these alloys also have a fault, such as not having sufficient creep resistance in the application as which a high order former stability is required, while it has high ductility, and the product which improved them is demanded.

[0007]

[Means for Solving the Problem] In order that the unleaded solder of this invention may solve the above-mentioned technical problem, since most, the composition is characterized by all of 1.0 - 3.0 % of the weight of Ag, 0.5 - 2.0 % of the weight of Cu, 1.0 - 10.0 % of the weight of Bi, and Sn remainders, or its thing [becoming].

[0008]

[Function] Since this invention has the above-mentioned configuration, it performs the following operations.

[0009] Although it is effective in improving a mechanical property while melting temperature is reduced by adding Ag to principal component Sn, 1.0 or less % of the weight of Ag additions of the effect is inadequate, and even if it adds 3.0% of the weight or more on the other hand, the effect is disadvantageous also at the point that become cost quantity few and liquidus-line

temperature becomes high.

[0010] By adding Cu to what added Ag to principal component Sn, detailed-ization of an organization is measured and a mechanical strength is improved further. In the addition with less Cu than 0.5 % of the weight, if there are few the effects and 2.0 % of the weight is exceeded, liquidus-line temperature will rise abruptly and they will do thermal trauma to parts or a printed circuit board.

[0011] By adding Bi to what added Ag and Cu to principal component Sn, melting temperature is lowered and thermal trauma of parts or a printed circuit board is prevented. With 1.0 or less % of the weight of Bi additions, there are few the effects, at 10.0 % of the weight or more, a crystal makes it big and rough and a mechanical strength falls easily.

[0012] this invention can offer the unleaded solder excellent in the wettability and the mechanical property while Sn-Pb can bring melting temperature close to the melting point (183 degrees C) of phase solder as much as possible by setting Sn, Ag, Cu, and Bi as the above-mentioned domain.

[0013]

[Example] As the example 1 - an example 3, the unleaded solder of the composition shown in Table 2 was manufactured. And the melting temperature and wettability were evaluated.

[0014]

[Table 2]

【表 2】 実施例

実施例	組成 (重量%)				溶融温度 (°C)		ぬれ性
	S n	B i	A g	C u	固晶線	液晶線	
1	残部	7.5	2.0	0.5	177	209	○
2	残部	2.0	1.5	1.0	178	221	○
3	残部	10	3.0	2.0	178	206	○

[0015] Wettability evaluation created the Class [B] (1.6mm of wire sizes) solder JIS property containing resin which contains a flux 3% weight by each solder composition, and used as the test piece what was cut in the shape of a ring so that the weight of the solder containing resin might be set to 300mg. After it placed the test piece on the oxidized copper plate (30x30x0.3mm) and it carried for 30 seconds on the hot plate with a liquidus-line temperature of +50 degrees C, the rate of a breadth of JIS-Z-3197 and 6.10. estimated it. In 90% or more of the rates of a breadth, ** and 79 - 70% considered as **, and 69% or less considered [0 and 89 - 80%] as x.

[0016] All, the example 1 - the example 3 were able to have the good wettability, and melting temperature was also able to carry out [wettability] the considerable fall as compared with the conventional example so that clearly from Table 2. Moreover, although not clearly shown in an experimental result, the improvement of a mechanical property was also able to be aimed at by including Cu and Ag.

[0017] The unleaded solder of this invention is fabricated and used for various gestalt, such as a rod, a wire, a ribbon, a pli form, and powder. Moreover, although the example 1 - the example 3 consist of four kinds of composition, Sn, Bi, Ag, and Cu, they may add Fe of a minute amount etc. in addition to this, and may manufacture unleaded solder.

[0018]

[Effect of the Invention] According to this invention, melting temperature can be made low and the good unleaded solder of a wettability and a mechanical property can be offered.

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(54) 【発明の名称】 無鉛はんだ

(57) 【要約】

【目的】 溶融温度を低くでき、ぬれ性及び機械的特性の良好な無鉛はんだを提供する。

【構成】 はんだの組成が、Ag 1.0～3.0重量%、Cu 0.5～2.0重量%、Bi 1.0～10.0重量%、Sn残部のすべて又はその大部分、からなる無鉛はんだ。

【特許請求の範囲】

【請求項1】 はんだの組成が、Ag 1.0～3.0重量%、Cu 0.5～2.0重量%、Bi 1.0～10.0重量%、Sn残部のすべて又はその大部分、からなる無鉛はんだ。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、電子機器や電機機器の回路基板上に小型のチップ部品や半導体部品を精度良く実装するために主として用いられる無鉛はんだに関するものである。

【0002】

*

【表1】 従来例

従来例	組成(重量%)				熔融温度(℃) (共晶線)	ぬれ性
	Sn	Ag	Sb	Zn		
1	残部	3.5	—	—	221	□
2	残部	—	—	9.0	199	×
3	残部	—	5.0	—	240	△

【0005】

【発明が解決しようとする課題】しかし従来例1(Sn-Ag合金系)では、融点が221℃と高くなり、はんだ付け部品、あるいはプリント基板等を損傷する場合がある。また、従来例2(Sn-Zn合金系)は、Znが酸化を受けやすいため大気中でははんだ付けに問題があり、ぬれ性が極めて悪い。また、従来例3(Sn-Sb合金系)は、融点が240℃と高く、ぬれ性も良好でなく、またSbは若干の毒性を有する等の問題点が今まで未解決のままである。

【0006】周知のようにこれらの合金は、高い延性を有する反面、高次元安定性が要求される応用には、十分なクリープ抵抗を持っていないなどの欠点もあり、それらを改良した製品が要求されている。

【0007】

【課題を解決するための手段】本発明の無鉛はんだは、上記課題を解決するため、その組成が、Ag 1.0～3.0重量%、Cu 0.5～2.0重量%、Bi 1.0～10.0重量%、Sn残部のすべて又はその大部分、からなることを特徴とする。

【0008】

【作用】本発明は上記構成を有するので、次のような作用を営む。

【0009】主成分SnにAgを添加することにより熔融温度を低下させると共に機械的特性を改善する効果があるが、Ag添加量1.0重量%以下ではその効果は不

十分で、一方3.0重量%以上添加してもその効果は少なくコスト高となり、液相線温度が高くなる点でも不利である。

【0010】主成分SnにAgを添加したものにCuを添加することにより、組織の微細化を計り、機械的強度は更に改善される。Cuは、0.5重量%より少ない添加では、その効果は少なく、また、2.0重量%を超えると、液相線温度が急上昇し、部品やプリント基板に熱的損傷を与える。

【0011】

【表1】

【0012】主成分SnにAg、Cuを添加したものにBiを添加することにより、熔融温度を下げた部品やプリント基板の熱的損傷を防止する。Bi添加量1.0重量%以下ではその効果は少なく、10.0重量%以上では、結晶が粗大化し、脆く機械的強度が低下する。

【0013】本発明はSn、Ag、Cu、Biを上記範囲に設定することにより、熔融温度をSn-Pb共相はんだの融点(183℃)にできるだけ近づけることができると共に、ぬれ性及び機械的特性にすぐれた無鉛はんだを提供することができる。

【0014】【実施例】実施例1～実施例3として、表2に示す組成の無鉛はんだを製作した。そしてその熔融温度とぬれ性を評価した。

【0015】【表2】

【0016】

【0017】

【0018】

【表2】

【表2】 実施例

実施例	組成 (重量%)				溶融温度 (°C)		ぬれ性
	S n	B i	A g	C u	固晶線	液晶線	
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【0015】ぬれ性評価は、各はんだ組成でフラックス3%重量を含有するやに入りはんだJIS特性B級（線径1.6mm）を作成し、やに入りはんだの重量が300mgになるようにリング状に切断したものを試験片とした。試験片は、酸化処理した銅板（30×30×0.3mm）の上に置き、液相線温度+50°Cのホットプレート上に30秒間のせた後、JIS-Z-3197、6.10.の広がり率により評価した。広がり率90%以上が○、89～80%が□、79～70%が△、69%以下が×とした。

【0016】表2から明らかなように、実施例1～実施例3は、いずれもぬれ性が良く、溶融温度も従来例に比較し、相当低下させることができた。また実験結果には*

*明示していないが、Cu、Agを含むことにより機械的特性の改善も図ることができた。

【0017】本発明の無鉛はんだは、棒、ワイヤ、リボン、ブリフォーム、粉末等の種々の形態に成形して用いられる。また実施例1～実施例3は、Sn、Bi、Ag、Cuの4種類のみの組成からなるものであるが、これ以外に微量のFe等を加えて、無鉛はんだを製作してもよい。

【0018】

【発明の効果】本発明によれば、溶融温度を低くでき、ぬれ性及び機械的特性の良好な無鉛はんだを提供することができる。

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